Research Pays Off Series

Safer, Smarter, Sustainable Pavements through Innovative Research

Series Kickoff – Road Research Updated Website

Ben Worel

June 16, 2015

We all have a stake in A TO B

Introduction to “Research Pays Off” Series

- **Why its needed**
  - Highlight research topics that will make an impact on the work done here in the state of Minnesota and around the country.
  - Get research directly to customers
- **Format**
  - Consistent
    - 3rd Tuesday of each month
  - Quick
    - 30 minute presentation / input from customer
    - Rest online discussion
    - No more than 1 hour
  - Easy
    - Online – anyone can attend

Introduction to “Research Pays Off” Series

- **Series Topics**
  - Research topics that impact engineers
  - Topics selected by customers needs

2015 Dates	Topic	Speaker
June 16	"Seminar Kick-Off" Using Road Research's new website to better understand todays research topics and how to gain access to MnROAD pavement performance data	Worel
July 21	Chip Seals - Use and Benefit to Minnesota	Geib
Aug 18	Results from the Minnesota Whitetopping Field Review thougout the State	Burnham
Sept 15	Concrete Rehabilitation (Patching and Grinding) including a review of I-394	Izevbekhai
Oct 20	Thermal Cracking and the Use of DCT Performance Testing	Dai
Nov 17	TBD - what ideas do you have?	
Dec 15	TBD - what ideas do you have?	

  - Speaker + Customer Followup
  - Seminars can be recorded
  - Saved for future use - Road Research Web Page “Research Topics”

MnROAD

Calendar of Events

Calendar

2015 events

MnROAD interstate closure

Scheduled dates.

What topics of interest?

Research Pays Off Seminar Series

Road Research will provide a monthly seminar to highlight research topics that will make an inpact on the work done here in the state of Minnesota and around the country. **Each seminar will take place every third Tuesday of the month from 9 to 10 a.m. CDT**. Seminars will be recorded and archieved on the Road Research Topic pages for further use. Let us know which topics you would like covered in future seminars.Contact us to get on our distribution list or use this link to join the meeting.

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Link to join the meeting

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Road Research Updated Web Site

Minnesota Department of Transportation

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Road Research

Improving the way we design, construct and maintain our highways

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About Road Research

Road Research is part of MnDOT's Office of Materials and Road Research. Our products and services help advance the state of the practice of pavement design, construction and maintenance by conducting and participating in pavement and materials research projects, implementation of research results, and supporting practitioners.

We invite you to explore our research and testing facilities. MnROAD, our cold weather pavement testing center, works in conjunction with MnDOT's Material Lab located in Maplewood, Minnesota.

Search our entire list of publications.

MnROAD pavement engineer Len Palek.

Directions

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LTPP Profiler Rodeo

June 8-15

FHWA contact - Larry Wiser)

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Minnesota's Cold Weather Pavement Testing Facility

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- Phase 1 - Lessons learned from the first ten years of research performed at MnROAD from 1994-2004.
- Phase 2 - *Coming soon*

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MnROAD

MnROAD Test Cells

Test Sections

Containing over 50 test cells, MnROAD has a variety of different cell locations, such as driveways or parking lots, which study small scale experimental pavement designs or materials. Research participation on any of the MnROAD test cells is both welcomed and encouraged.

MnROAD Cell Maps and Videos/Pictures

- Mainline (I-94)
- Low Volume Road
- Farm Loop

MnROAD Cell Description Assistance

- Simple Test Cell Guide
- MnROAD Cell Finder Tool (spreadsheet to find cell # or design feature)
- MnROAD Surface Types (PDF, 3MB, 36 pages)

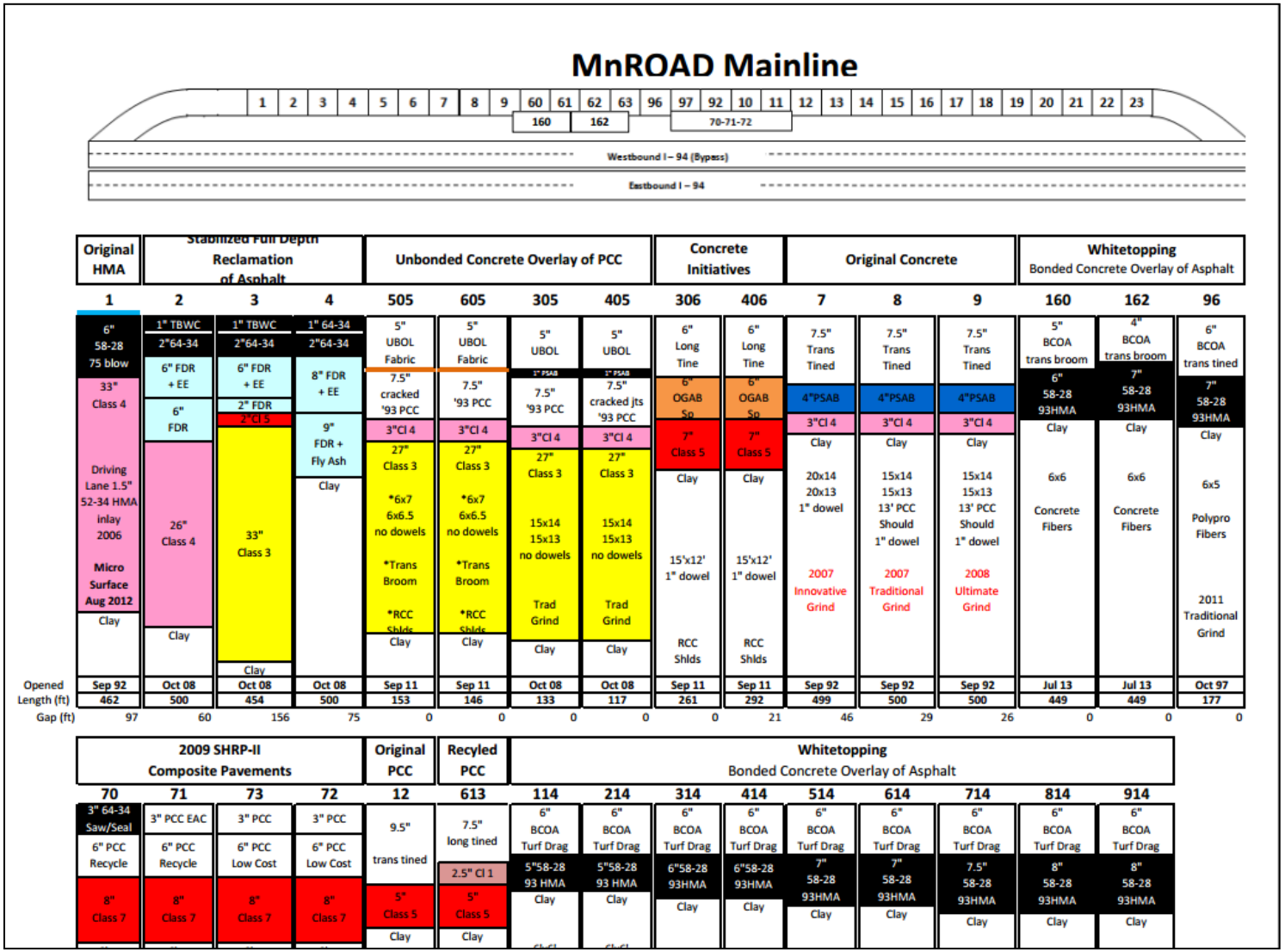
MnROAD Data Packets

- Data - Cross Sections by Facility Type
- Data - Design Details by Pavement Type
- 2014 Cell and Transition Distances (PDF)

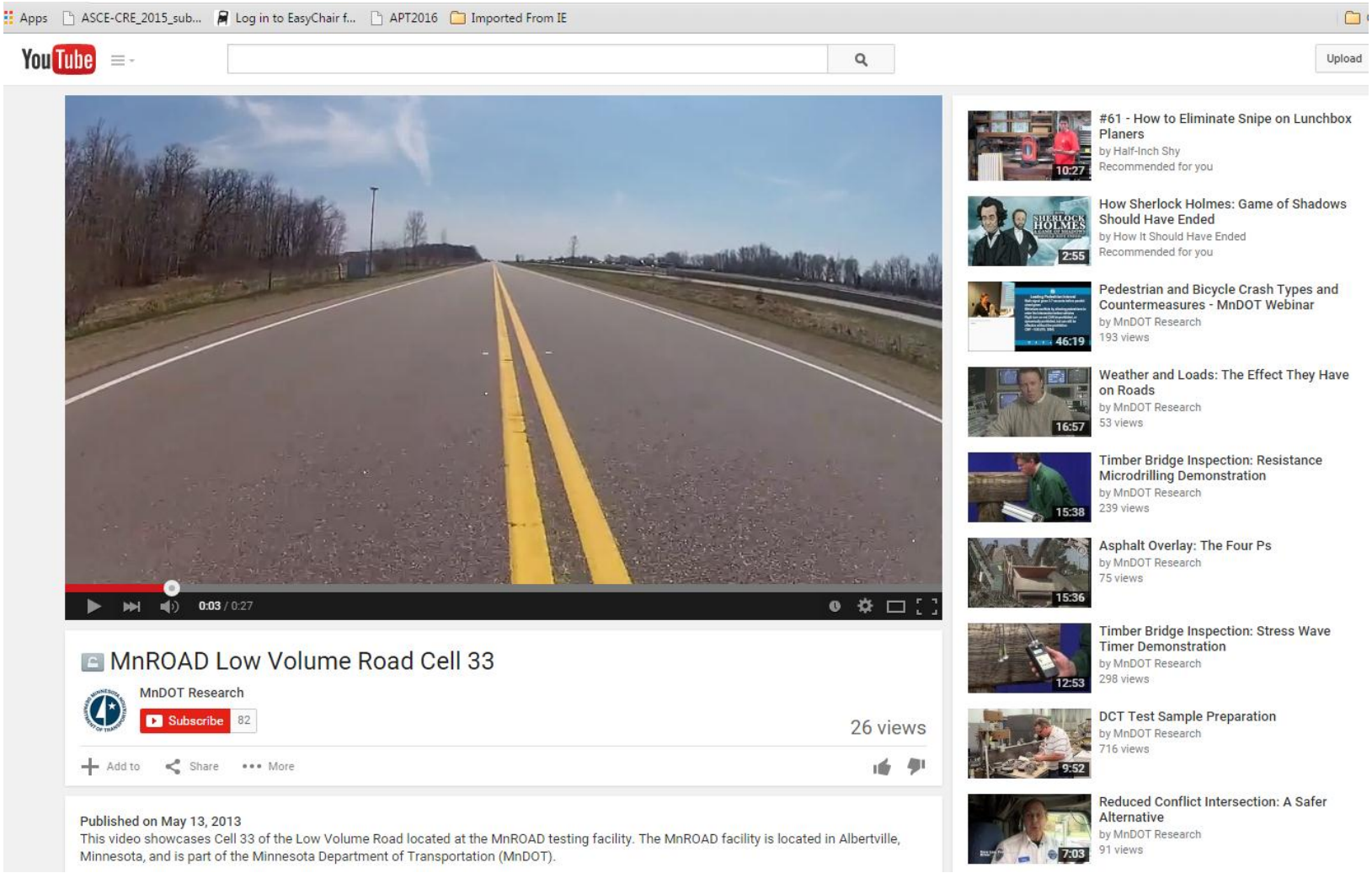
Original Test Cell Numbering

Constructed from 1991 until 1994, the original test cells are referred to by their involvement in MnROAD's Phase I research. The test cells were sequentially numbered 1 through 46 with more cell additions added between 1997 through 2006. New cell additions during Phase I were either designated with a recycled previous number or assigned an available number below 99.

MnROAD Mainline and LVR "Cell Maps"



MnROAD Cell Videos (Drive Online)



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MnROAD Cell Finder Tool

	General Information										Co
Cell	Roadwa	General Materia	Layer #	Lane	Width (fee	Thickness (mm)	Layer Description	Drainage	Shoulder Type	Layer Start	L
1	Mainline	Asphalt	7	Driving	12	38.1	Hot Mix Asphalt Phase I	None	HMA	28-Sep-93	28-
1	Mainline	Asphalt	6	Driving	12	38.1	Hot Mix Asphalt Phase I	None	HMA	25-Sep-93	28-
1	Mainline	Asphalt	4	Driving	12	76.2	Hot Mix Asphalt Phase I	None	HMA	24-Sep-93	24-
1	Mainline	Asphalt	3	Driving	12	6.35	Flexible Microsurfacing	None	HMA	27-Jun-12	28-
1	Mainline	Gravel	2	Driving	12	838.2	Class 4 Special gradation for MnROAD - Base	None	HMA	17-Jul-93	29
1	Mainline	Asphalt	2	Driving	12	38.1	Hot Mix Asphalt - GCBD study	None	HMA	7-Jul-06	7-
1	Mainline	Clay	1	Driving	12	0	Clay Subgrade R=12	None	HMA	30-Aug-91	8-
1	Mainline	Asphalt	1	Driving	12	-38.1	Milling	None	HMA	7-Jul-06	7-
1	Mainline	Asphalt	4	Left Shldr	10	50.8	Hot Mix Asphalt	None	HMA	5-Oct-93	5-
1	Mainline	Gravel	3	Left Shldr	10	101.6	Class 5 Shouldering Aggregate	None	HMA	1-Oct-93	1-
1	Mainline	Gravel	2	Left Shldr	10	838.2	Class 4 Special gradation for MnROAD - Base	None	HMA	17-Jul-93	29
1	Mainline	Clay	1	Left Shldr	10	0	Clay Subgrade R=12	None	HMA	30-Aug-91	8-
1	Mainline	Asphalt	6	Passing	12	38.1	Hot Mix Asphalt Phase I	None	HMA	28-Sep-93	28-
1	Mainline	Asphalt	5	Passing	12	38.1	Hot Mix Asphalt Phase I	None	HMA	25-Sep-93	25-
1	Mainline	Asphalt	4	Passing	12	76.2	Hot Mix Asphalt Phase I	None	HMA	24-Sep-93	24-
1	Mainline	Gravel	2	Passing	12	838.2	Class 4 Special gradation for MnROAD - Base	None	HMA	17-Jul-93	29
1	Mainline	Clay	1	Passing	12	0	Clay Subgrade R=12	None	HMA	30-Aug-91	8-
1	Mainline	Asphalt	1	Passing	12	6.35	Flexible Microsurfacing	None	HMA	27-Jun-12	28-
1	Mainline	Asphalt	5	Right Shldr	4	50.8	Hot Mix Asphalt	None	HMA	5-Oct-93	5-
1	Mainline	Gravel	3	Right Shldr	4	101.6	Class 5 Shouldering Aggregate	None	HMA	1-Oct-93	1-
1	Mainline	Gravel	2	Right Shldr	4	838.2	Class 4 Special gradation for MnROAD - Base	None	HMA	17-Jul-93	29
1	Mainline	Clay	1	Right Shldr	4	0	Clay Subgrade R=12	None	HMA	30-Aug-91	8-
2	Mainline	Asphalt	7	Driving	12	12.7	Microsurfacing - Applied using MiniMac machine	None	HMA	15-Aug-03	15-
2	Mainline	Asphalt	6	Driving	12	38.1	Hot Mix Asphalt Phase I	None	HMA	28-Sep-93	28-
2	Mainline	Asphalt	5	Driving	12	38.1	Hot Mix Asphalt Phase I	None	HMA	25-Sep-93	25-
2	Mainline	Asphalt	5	Driving	12	19.05	Ultra Thin Bonded (Novachip)	None	HMA	29-Sep-08	29-

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Road Research

MnROAD Documentation and Data

MnROAD Data

MnROAD test sections are routinely monitored to track the changes in pavement performance over time. Several types of measurements are made continually throughout cell life. Some measurements are made seasonally and others annually. Use the table below to access MnROAD data and the processes used to collect the data.

Current data collection schedule: Frequency of data collection (PDF).

MnROAD's most recent data release (data release 1.0) allows researchers to access much of the data online and is also incorporated in the tables below. Due to the volume and complexity, some data (e.g. raw ride quality, pre-2008 FWD time history files, dynamic load data, etc.) is not included in the data release. This data is stored offline and available on request. If you don't see the data you're looking for please contact us.

Test Section Performance Report - Select a test section and see current pavement performance trends.

Cell Information (Layers, Events, etc.)	Tab includes test section characteristics from subgrade to pavement surface with graphical representations both current and historical. Links are provided to pictures and video of individual cells.
Lab Testing (HMA, PCC, Base)	This tab links to discussions on materials sampling, lab procedures and summary results of quality control testing.
Sensors (Static, Dynamic)	Descriptions of current and historical sensors used at MnROAD as well as links to datasets.
Field Monitoring (Ruts, Ride, Texture, Cracks, Strength, etc.)	Procedures and data for pavement distress, surface characteristics, and other non-destructive testing data.
Weather	Links to MnROAD weather station sensors and data.
Traffic	Traffic sensor descriptions with current and historical data.

Hot Mix Asphalt (HMA) Summary For Cell 19-1

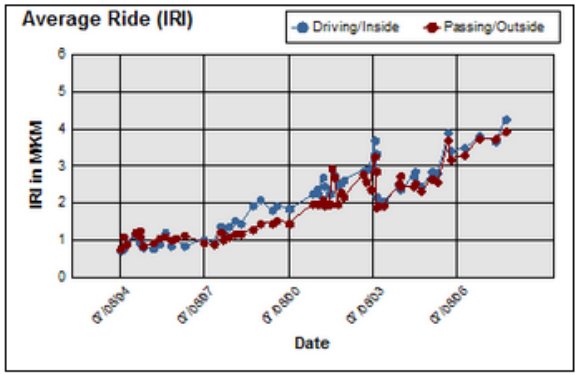
Cell Number:	19	**Cell Description:**	Phase I HMA 10 Year Design
Construction Nbr:	1		
Built:	08/03/1993	**Reconstructed:**	05/01/2008
STA:	121755 - 122255	**Oil Grade:**	AC-20 / PG 64-22
Sholder Type:	HMA	**HMA Design:**	Marshall (35 Blow) - 2331
Design Life:	10	**Drainage System:**	None

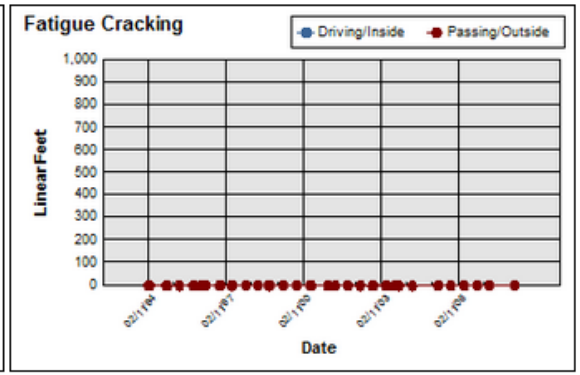
Layer Information

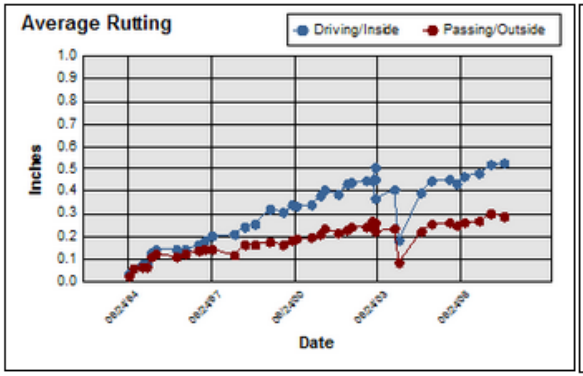
Layer #	Inches	Completed	Material
7	0.50	08/18/03	Microsurfacing - Applied using MiniMac machine
6	1.50	07/29/93	Hot Mix Asphalt Phase I
5	1.50	07/28/93	Hot Mix Asphalt Phase I
4	2.00	07/21/93	Hot Mix Asphalt Phase I
3	3.00	07/20/93	Hot Mix Asphalt Phase I
2	28.00	06/28/93	Class 3 Special gradation for MnROAD - Base
1	0.00	06/02/92	Clay Subgrade R=12

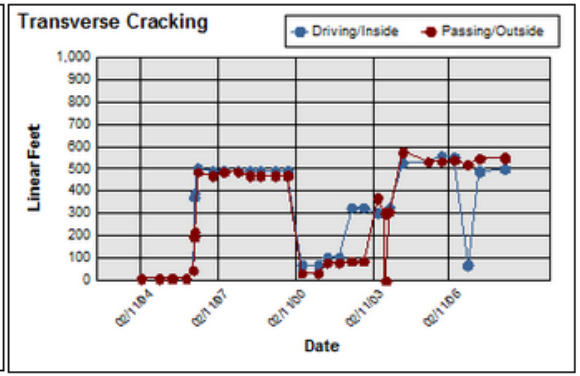
Cell Event History

Date	Activity
07/29/93	Original Construction
08/10/98	Test Pit
04/24/00	Crack Sealing
05/21/03	Crack Sealing









MnROAD Portland Cement Concrete (PCC) Summary
For Cell 5-1

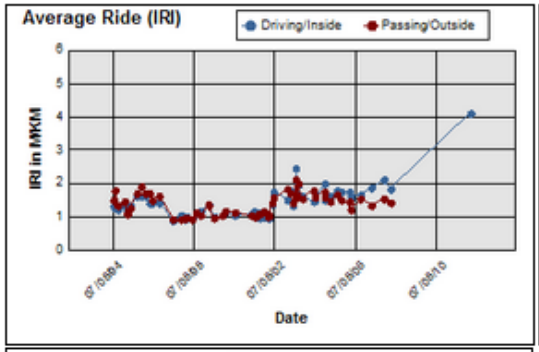
Cell Number:	5	**Cell Description:**	5 year design PCC - Widened lane - Deep base layer
Construction Nbr:	1		
Built:	10/15/1992	**Surface Texture:**	Transverse Tine
Reconstructed:	05/16/2015	**Panel Length (ft):**	20
STA:	112530 - 113130	**Panel Width (ft):**	13/14
Shoulder Type:	HMA	**Dowel Size (in):**	1
Design Life:	5	**Tie Bars:**	
Concrete Fiber:		**Joint Sealant:**	Silicone
Drainage System:	None	**Longitudinal Sealant:**	
		Joint Orientation:	Skew

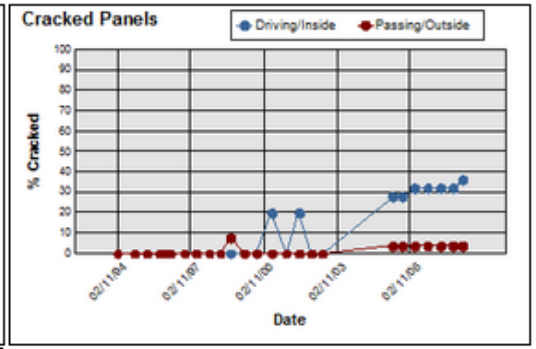
Layer Information

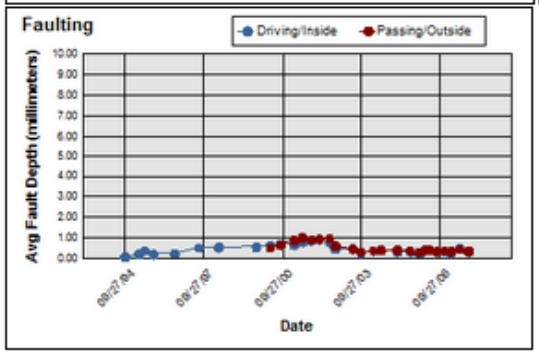
Layer #	Inches	Completed	Material
4	7.10	09/15/92	Portland Cement Concrete - Mnroad Phase 1
3	2.99	08/10/92	Class 4 Special gradation for MnROAD - Base
2	27.01	07/25/92	Class 3 Special gradation for MnROAD - Base
1	0.00	07/07/92	Clay Subgrade R=12

Cell Event History

Date	Activity
09/15/92	Original Construction
05/30/04	Patching
06/20/05	Patching
08/09/06	Patching

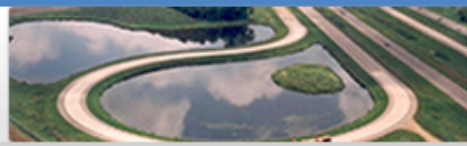






Road Research

MnROAD Sensors - Environmental and Dynamic



Environmental and Dynamic Sensors

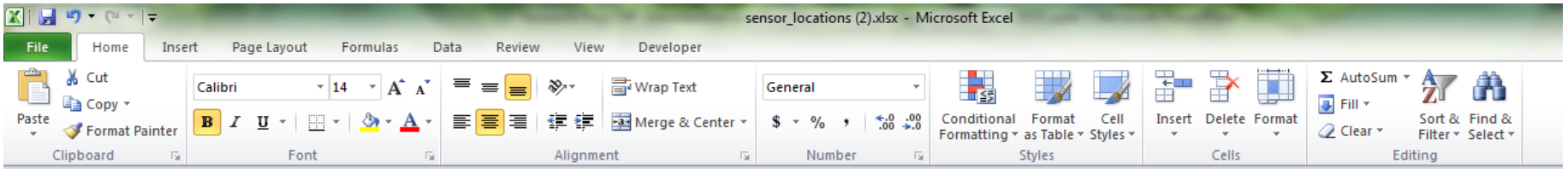
Measuring pavement structure responses to environmental change and dynamic loading are among the most important ongoing tasks at MnROAD. Many of the measurements are accomplished through use of electronic instruments. More than 10,000 electronic sensors have been installed and monitored since 1993. See factsheet for information on the materials materials and equipment necessary for data collection at MnROAD.

Environmental Sensors (static)	Environmental or static measurements are usually made continuously for the life of the sensor or the cell. The time periods for data collection are most commonly 15 minutes. Environmental measurements include temperature, water content, humidity, soil pressure, pore water pressure, strain, electrical resistivity and often variants on these measures.
Dynamic Sensors (load response)	Dynamic or load response measurements are usually made seasonally using the MnROAD test vehicle to provide uniform pavement loading. The test cells are closed to public traffic during scheduled data collections and sensor load response is acquired in real time. Load test measurements may include stress, strain, displacement, pore water pressure, and accelerometer data.

Sensor Lookup Tool - A tool for finding sensors in MnROAD test cells.

MnROAD Site Infrastructure Factsheet (PDF, 1 MB, 3 pages) - A general discussion of materials and equipment necessary for data collection at MnROAD.

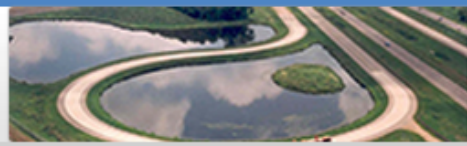
Sensor Lookup Tool



	A	B	C	D	E	F	G	H	I
1	CELL	MODEL	SEQ	DESCRIPTION	DATE INSTALLED	DATE REMOVED	STA	OFFSET FT	SENSOR DEPTH_IN
2	1	DT	1	Linear Variable Differential Transducer	1-Aug-93	1-Jul-06	110645	-10.64	3
3	1	DT	2	Linear Variable Differential Transducer	1-Aug-93	1-Jul-06	110647	-9.61	3
4	1	DT	3	Linear Variable Differential Transducer	1-Aug-93	1-Jul-06	110649	-8.64	3
5	1	DT	4	Linear Variable Differential Transducer	1-Aug-93	1-Jul-06	110651	-10.59	3
6	1	DT	5	Linear Variable Differential Transducer	1-Aug-93	1-Jul-06	110653	-9.57	3
7	1	DT	6	Linear Variable Differential Transducer	1-Aug-93	1-Jul-06	110655	-8.63	3
8	1	NP	1	Neutron Probe	1-Aug-93	1-Jul-06	110643	-5.92	0.24
9	1	OS	1	MnROAD Open Stand Pipe	1-Aug-93	1-Jul-06	110633	-25	180
10	1	PG	1	Dynamic Normal Pressure Gauge - Geokon 3500	1-Aug-93	18-Nov-09	110637	-8.96	5.76
11	1	PG	2	Dynamic Normal Pressure Gauge - Geokon 3500	1-Aug-93	18-Nov-07	110637	-8.79	21.12
12	1	PG	3	Dynamic Normal Pressure Gauge - Geokon 3500	1-Aug-93	18-Nov-09	110637	-10	5.76
13	1	PG	4	Dynamic Normal Pressure Gauge - Geokon 3500	1-Aug-93	18-Nov-09	110637	-9.83	21.24
14	1	PG	5	Dynamic Normal Pressure Gauge - Geokon 3500	1-Aug-93	18-Nov-09	110637	-11.03	5.64
15	1	PG	6	Dynamic Normal Pressure Gauge - Geokon 3500	1-Aug-93	18-Nov-09	110637	-10.86	21.12
16	1	PK	1	Dynamic Pressure Gauge	1-Aug-93	19-Nov-09	110637	-9.77	38.88
17	1	RP	1	Resistivity Probe	1-Sep-93	31-May-99	110641	-9.78	10.2
18	1	TC	1	MnROAD Thermal Couple Tree - Omega	1-Aug-93	1-Jul-06	110641	-9.76	1.2
19	1	TC	2	MnROAD Thermal Couple Tree - Omega	1-Aug-93	1-Jul-06	110641	-9.76	2.16
20	1	TC	3	MnROAD Thermal Couple Tree - Omega	1-Aug-93		110641	-9.76	6.24

Road Research

MnROAD Sensors - Environmental and Dynamic



Environmental and Dynamic Sensors

Measuring pavement structure responses to environmental change and dynamic loading are among the most important ongoing tasks at MnROAD. Many of the measurements are accomplished through use of electronic instruments. More than 10,000 electronic sensors have been installed and monitored since 1993. See factsheet for information on the materials materials and equipment necessary for data collection at MnROAD.

Environmental Sensors (static)	Environmental or static measurements are usually made continuously for the life of the sensor or the cell. The time periods for data collection are most commonly 15 minutes. Environmental measurements include temperature, water content, humidity, soil pressure, pore water pressure, strain, electrical resistivity and often variants on these measures.
Dynamic Sensors (load response)	Dynamic or load response measurements are usually made seasonally using the MnROAD test vehicle to provide uniform pavement loading. The test cells are closed to public traffic during scheduled data collections and sensor load response is acquired in real time. Load test measurements may include stress, strain, displacement, pore water pressure, and accelerometer data.

Sensor Lookup Tool - A tool for finding sensors in MnROAD test cells.

MnROAD Site Infrastructure Factsheet (PDF, 1 MB, 3 pages) - A general discussion of materials and equipment necessary for data collection at MnROAD.

Road Research

MnROAD - Environmental Sensors

Environmental Sensors (Static)

The matrix below contains the different sensor type descriptions, installation methods, and some of the data collected. Due to the complexity and amount of the data please contact us for custom data requests. Most of these documents are PDFs.

Sensor Type	Sensor Type Description	Sensors located in the following layers				Data
		HMA	PCC	Base	Subgrade	
Temperature Temp. Measurements TC Tree Construction TC Tree Installation	**Thermocouples** TC XB	x	x	x	x	Get TC Data
	Thermistors ET TH XD XH XL XM XT XV		x	x	x	Request
Volumetric Water (Moisture) Content Moisture Measurements Moisture Installation	**Moisture Gauge** EW RE TD			x	x	Request
Relative Humidity Building MH Sensors	**Humidity Gauge** MH MP MR		x	x		Request
Matric Potential Building WM Trees	**Resistance** WM		x	x	x	Request
	Heat Dissipation HD			x	x	Request
Stress	**Vertical Pressure** PT			x	x	Request
	Lateral Pressure					Request

Sensor Documentation

MnROAD [Safer, Smarter, Sustainable Pavements through Innovative Research]

January 2014

Temperature Sensing at MnROAD

General Description

Temperature sensing at MnROAD is accomplished with either thermocouples or thermistors. Predominately, thermocouples are used. The thermistors used at MnROAD are generally integrated into other instruments (e.g. Decagon ECH_2O-TE and 5TE Water Content Sensors, Geokon 4200A Vibrating Wire Strain Gauge, Geokon 4800 Circular Earth Pressure Cell). The two-letter designations for temperature-sensor data are TC for thermocouples, ET, XV and RT for thermistors. These thermistors are integrated components of other instruments.

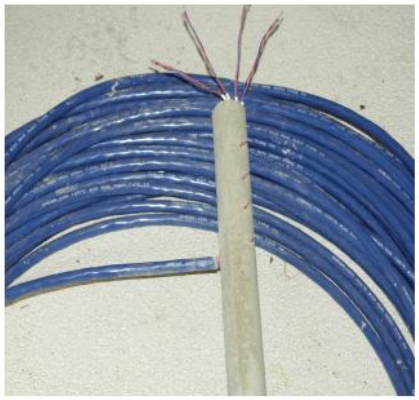


Figure 1: 8-Sensor TC Tree

Pre-manufactured thermocouples are rarely used. The general approach is to build vertical thermocouple arrays using type T (copper-constantan) thermocouple extension cable.

Thermocouples work for measuring temperature because the joining of two dissimilar metal conductors generates a small voltage, called the Seebeck voltage or thermoelectric effect, which is proportional to the temperature difference between the hot (point of interest) end and a reference junction. Thermocouples are passive sensors. That is, they do not require an excitation voltage to generate a response to environmental change. Type T junctions typically have sensitivity of approximately 43 μV/°C. The measurement instrument is created simply by twisting the bare ends of the copper/constantan pairs together and soldering the junction. The reference junction is located within the data logger at the data acquisition point. A precision of ± 1°C has been achieved.

Thermistors are temperature-sensitive resistors. Unlike thermocouples, thermistors do require an external voltage to determine the resistance of the sensor at the time of measurement

Access to Sensor Data Online

www.mrr.dot.state.mn.us - /research/dataproduct/Data R
Information/Sensor Data by Year/TC - Thermal Couple/

[To Parent Directory]

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Road Research

MnROAD Documentation and Data

MnROAD Data

MnROAD test sections are routinely monitored to track the changes in pavement performance over time. Several types of measurements are made continually throughout cell life. Some measurements are made seasonally and others annually. Use the table below to access MnROAD data and the processes used to collect the data.

Current data collection schedule: Frequency of data collection (PDF).

MnROAD's most recent data release (data release 1.0) allows researchers to access much of the data online and is also incorporated in the tables below. Due to the volume and complexity, some data (e.g. raw ride quality, pre-2008 FWD time history files, dynamic load data, etc.) is not included in the data release. This data is stored offline and available on request. If you don't see the data you're looking for please contact us.

Test Section Performance Report - Select a test section and see current pavement performance trends.

Cell Information (Layers, Events, etc.)	Tab includes test section characteristics from subgrade to pavement surface with graphical representations both current and historical. Links are provided to pictures and video of individual cells.
Lab Testing (HMA, PCC, Base)	This tab links to discussions on materials sampling, lab procedures and summary results of quality control testing.
Sensors (Static, Dynamic)	Descriptions of current and historical sensors used at MnROAD as well as links to datasets.
Field Monitoring (Ruts, Ride, Texture, Cracks, Strength, etc.)	Procedures and data for pavement distress, surface characteristics, and other non-destructive testing data.
Weather	Links to MnROAD weather station sensors and data.
Traffic	Traffic sensor descriptions with current and historical data.

Road Research

MnROAD - Field Monitoring

Field Monitoring

MnDOT staff collects pavement performance data on each of its test sections in a consistent documented method. The table below provides a description of the monitoring along with links to the latest data. Note: Most documents are in PDF form.

Measurement Grouping	Monitoring Method (Description of data collection)	View the Data	Link to the Data		
			Asphalt	Concrete	Composite
Strength	Falling Weight Deflectometer Lightweight Deflectometer Dynamic Cone Penetrometer Nuclear Density Moisture Content		FWD LWD DCP Nuclear Moisture	FWD LWD DCP Nuclear Moisture	FWD LWD DCP N/A Moisture
Ride	Pavement Management Van Light weight Profiler	Ride Data	PM LISA	PM LISA	PM LISA
Distress	Distress (Crack) Surveys PCC Joint Faulting Lane/Shoulder Drop-Off Rutting PCC Cracked Panels HMA Cracking	PCC Faulting Data Rutting Data Cracked Panels Data HMA Cracking Data	Distress N/A Drop-off Rutting	Distress Faulting Drop-off N/A	Distress Faulting Drop-off Rutting
Texture	Sand Patch Friction Tester (Locked Wheel) Circular Texture Meter		Sand Friction CTM	Sand Friction CTM	Sand Friction CTM
Noise	On-board Sound Intensity Sound Absorption	OBSI Data	OBSI Sound	OBSI Sound	OBSI Sound

Monitoring Documentation

MnROAD [Safer, Smarter, Sustainable Pavements through Innovative Research]

Version 4 - February 2014

FWD (Falling Weight Deflectometer) Testing Guide

General Description

To measure the response of a pavement layer or system to a dynamic load, MnROAD has used a device known as the Falling Weight Deflectometer or "FWD." Measurements with the FWD have been obtained both routinely (on a monthly or seasonal basis), and also for specific load test studies and sensor response verification.

The FWD device consists of a loading plate, weight package, geophone sensors, and data acquisition equipment. Mounted to a trailer, the equipment is designed to simulate the impulse load of a passing wheel. As the weight package is lifted (hydraulically) and dropped (free fall), the plate applies a dynamic load to the pavement; simultaneously geophone sensors (spaced at specific distances from the load plate) capture the resulting deflection basin. The deflection basin can be used to evaluate the structural capacity of the system as well as back-calculate the modulus of the underlying layers.

Equipment

Since 1994, the standard FWD device used at MnROAD is the Dynatest Model 8000. Older versions of the operating control software were written in Microsoft DOS®. In 2008, a switch to Microsoft Windows® based control software was made. Output files are now in Microsoft Access® database file format.

Note that the location of the geophone sensors, relative to the center of the loading plate, has varied. Users need to verify the geophone sensor spacing for each FWD test before analyzing the data. As of May 2009 we have used 10 sensors and they are numbered and located at the following offsets:

Sensor Number	1	2	3	4	5	6	7	8	9	10
Distance (in)	0	8	12	18	24	36	48	60	72	-12

Road Research

MnROAD - Field Monitoring

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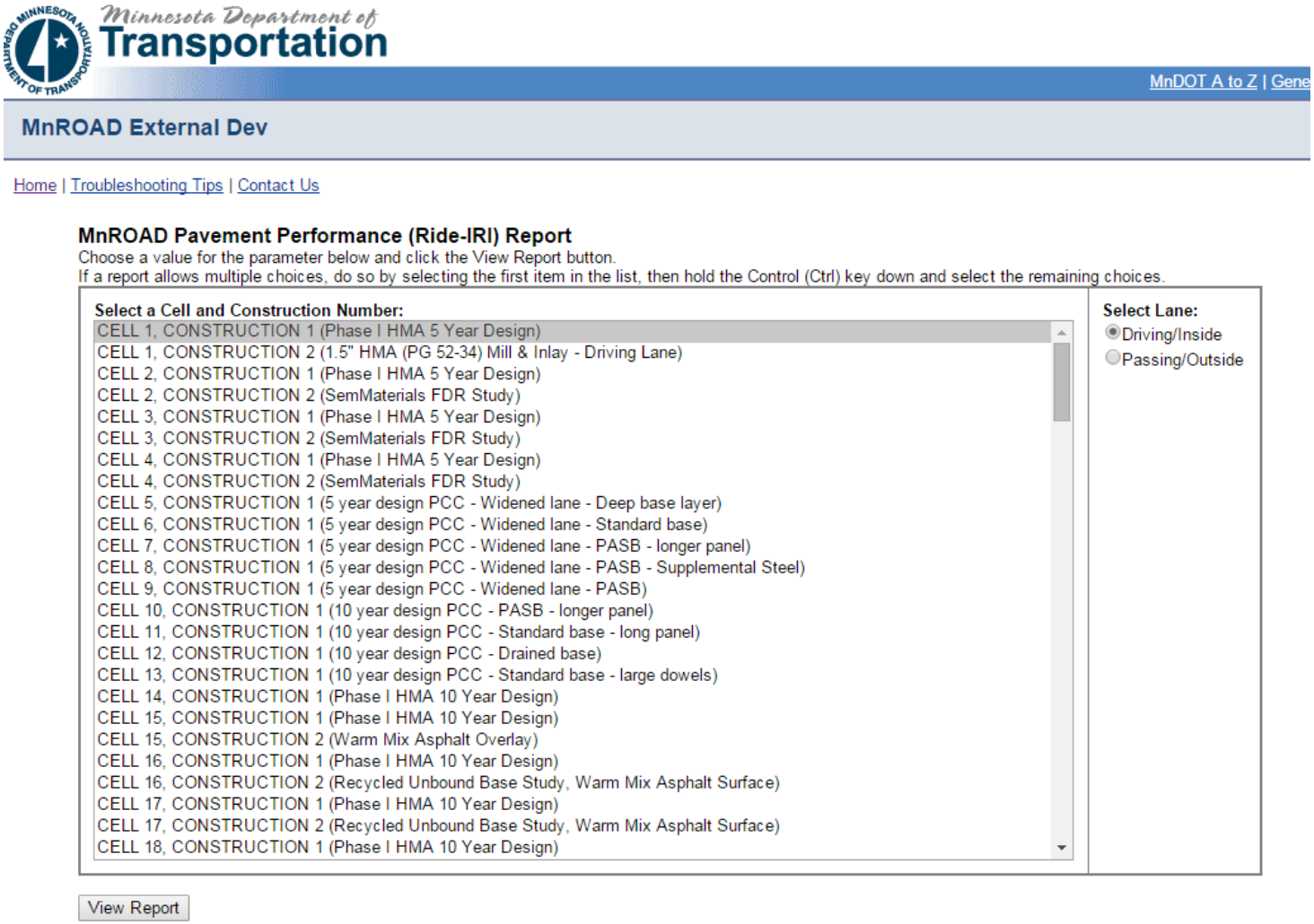
Texture	Sand Patch Friction Tester (Locked Wheel) Circular Texture Meter		Sand Friction CTM	Sand Friction CTM	Sand Friction CTM
Noise	On-board Sound Intensity Sound Absorption	OBSI Data	OBSI Sound	OBSI Sound	OBSI Sound

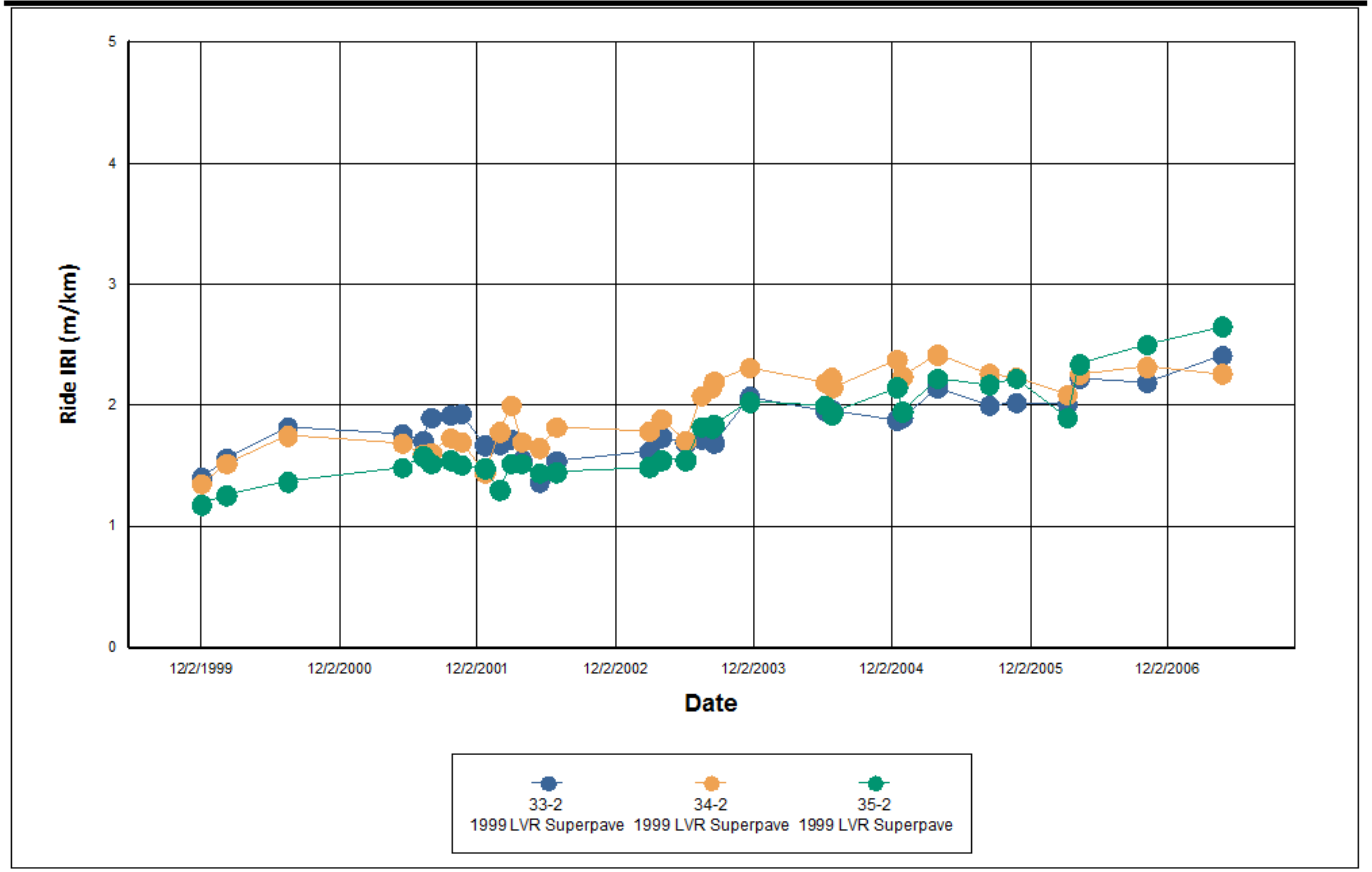
Performance Data – Select Cell(s)



Performance Data – Ride IRI

MnROAD Pavement Performance (Ride-IRI) Report

Selected Lanes: Driving/Inside

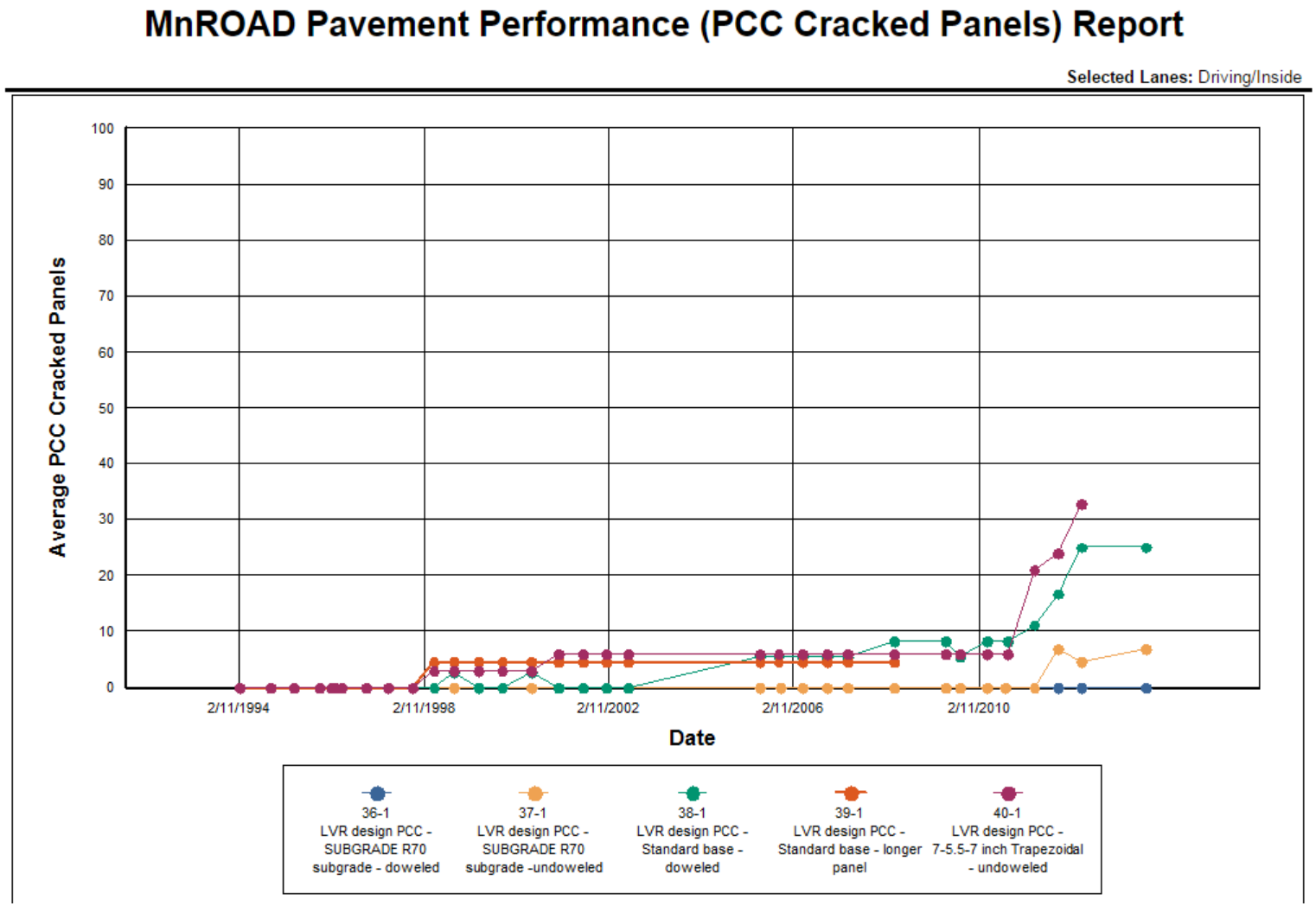


NOTE: This is only a summary of the MnROAD data. Please contact Ben Worel at ben.worel@state.mn.us for a complete set of data for any analysis work.

Report Date: 6/16/2015 7:43:32AM

Page 1 of 2

Performance Data – Cracked Panels



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MnROAD - Field Monitoring

Field Monitoring

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Noise	On-board Sound Intensity Sound Absorption	OBSI Data	OBSI Sound	OBSI Sound	OBSI Sound

Performance Data – Raw Data

www.mrr.dot.state.mn.us - /research/dataproduct/Data Release v 1.0 (Jan 2012)/C - Field Performance/Data/PCC - Concrete/Load Response/FWD/

[To Parent Directory]

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MnROAD pavement engineer Len Palek.

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Asphalt Design Process
Low Temperature Cracking/Performance Test
Asphalt Overlays
Recycled Asphalt Pavements/Shingles (RAP)
Warm Mix Asphalt
Longitudinal Construction Joints
Asphalt Binder Modification
Surface Characteristics HMA

Concrete

High Performance PCC Design (60-Year)
Thin Concrete Design
Concrete Bonded Overlays
Thin Concrete Overlays
Whitetopping (PCC Overlays of Existing HMA)
Composite Pavement Systems
Roller Compacted Concrete (RCC)
PCC Surface Characteristics (New Construction)

Porous & Pervious

Permeable HMA
Pervious Concrete (Pavements)
Pervious Concrete (Overlay)

Base Materials

Base Material Stabilized with High Carbon Fly Ash
Full Depth Reclamation Study
Recycled Unbound Pavement Materials

Topics

- Asphalt
- Concrete
- Porous & Pervious
- Base Materials
- Pavement Preservation
- General Studies

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Our research generates many publications. These publications have significantly advanced the understanding of pavement and materials performance.

- Search MnROAD Reports
- Full MnROAD Report List

Research Briefs

MnROAD Researchers generate small four-page reports designed to offer insight into the research being performed. They offer a variety of topics and give a succinct overview. See MnROAD Research Briefs.

Related Resources

- Office of Materials and Road Research
- NCAT Partnership
- MnDOT Library
- Research Services

Road Research – Topics Example

Low Temperature Cracking in Asphalt Pavements

Low temperature cracking is the most prevalent distress found in asphalt pavements built in cold weather climates. As the temperature drops the restrained pavement tries to shrink. The tensile stresses build up to a critical point at which a crack is formed. Thermal cracks can be initiated by a single low temperature event or by multiple warming and cooling cycles and then propogated by further low temperatures or traffic loadings.

The current Superpave specification attempts to address this issue by specifying a limiting low temperature for asphalt binders. However, the first phase of this project made it clear that testing asphalt mixtures is necessary to accurately predict low temperature cracking performance in the field. Furthermore, the testing must include more sophisticiated techniques based on fracture mechanics rather than the current practice of stiffness and strength testing.

Current Research Efforts

- DCT Sample Prep Video (Summer 2014)
- LTC Implementation (Fall 2014)
- Minnesota DCT Testing Update (Jan 2015)

Past Research Efforts

- LTC Pooled Fund Phase-II Project Page
  - Phase-II Final Report (2012 PDF)
- LTC Pooled Fund Phase-I Project
  - Phase-I Research Brief (2009 PDF)
  - Phase-I Executive Summary (2007 PDF)
  - Phase-I Final Report (2007 PDF)

Future Research Efforts

TBD

Products

Implementing LTC Spec in MN
Implementing LTC Spec in IA
Project Summary & Significant Contributions

Contact Information

David VanDeusen

Topic Format

- Short Description
- Current Research
- Past Research (Reports)
- Future Research
- Specifications / Guides
- Contact

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Research Reports and Briefs

Recent Reports

Investigation and Assessment of Colored Concrete Pavement
(PDF, 30 MB, 177 pages)
Interim with Appendix - Ally Akkari and Tom Burnham

2011 MnROAD Mainline Concrete Construction Report
Cells 5,6, and 63 Construction - Alexandra Akkari, Bernard Izevbekhai, and John Siekmeier

2010 MnROAD Construction Report
Cells 70, 71,72 Construction - Alexandra Akkari and Bernard Izevbekhai

2011 Concrete Cells Reconstruction, MnROAD, MN
(PDF, 3.4MB, 29 pages)
August 2011 - Federal Highway Administration (FHWA)

Evaluation of Polyvinyl Alcohol Fiber Reinforced Engineered Cementitious Composite for Thin- Bonded Concrete Overlay
(PDF, 4 MB, 48 pages)
March 2011 - Alexandra Akkari

Innovative Diamond Grinding on MnROAD cells 7, 8, 9 and 37
(PDF, 2.1 MB, 69 pages)

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- MnDOT Library
- Research Services
- Pavement Interactive
- TERRA

Thank You
Feedback / Discussion

We all have a stake in A TO B